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REGISTERED PROFESSIONAL CHEMICAL ENGINEERS—

CABLE ADDRESS "BETZPHIL" BENTLEY CODE

W. H. & L. D. Betz

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

GENERAL OFFICES AND LABORATORIES - GILLINGHAM AND WORTH STREETS

PHILADELPHIA 24, PENNSYLVANIA

REPORT OF STUDY AND INVESTIGATION

INDUSTRIAL WASTE TREATMENT

PENN RIVET & MACHINE COMPANY

PHILADELPHIA, PA.

BETZ PROJECT NO. 474-W

MARCH 10, 1947

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PHILADELPHIA 24, PENNSYLVANIA

March 10, 1947

Penn Rivet & Machine Company
3rd & Huntingdon Streets
Philadelphia 33, Pa.

Att: Mr. V. L. Bradford, General Manager

Gentlemen:

We present our preliminary report of study and investigation of industrial wastes from your plant, with recommendations for treatment. The report may be summarized as follows:

Appended: Analyses
Flow Scheme No. B-474-W-1

Very truly yours,

W. H. & L. D. BETZ

Max U. Priester

Max U. Priester
Assistant Director
Consulting Division

MUP:CK

SECTION NO. 1 - OUTLINE OF PROBLEM

Upon your authorization, the writer proceeded to your Philadelphia plant for the purpose of conducting a study and investigation of industrial wastes produced in your processing.

It was understood that you contemplate the construction of a new plant, the location of the proposed plant not having been definitely determined. With minor exceptions, the processing in the proposed plant will be similar to that which is carried on in the existing plant.

Our report covers the investigation of the wastes from the operating plant, and our recommendations, which appear later in the report, are to be applicable to the new plant when installed.

At the present time the polluted wastes emanate from two sources, namely, the mixed plating wastes and the washing and cleaning wastes. Flows were measured on each of these, the plating mill flowing between 3000 and 9000 gallons per day and the cleaning wastes approximately 700 gallons per day. These wastes, along with certain cooling waters and sanitary sewage, are discharged to the city sewers. Analysis of the polluted wastes appears on our certificate appended to this report.

Since you anticipate constructing a new plant, the purpose of our investigation is to determine the treatment method and estimated capital and operating costs for preparing the wastes for discharge to waters of the state or to a municipal sewerage system.

The Pennsylvania Pure Streams Law requires that industrial wastes discharged to waters of the state be free of toxic compounds, no excess alkalinity or acidity, and a minimum of suspended solids and oil. Recommendations appearing in our report will provide such treatment.

SECTION NO. 2 - DISCUSSIONS OF TREATMENT

We understand that in the proposed plant the volume of washing and cleaning wastes will be reduced by 50% to 75% and possibly completely eliminated. We have, however, included treatment of these wastes, in reduced volumes, in our recommendations. In addition, no provision is made for handling the sanitary sewage from the proposed plant, this to be treated separately or discharged to an approved sanitary sewerage system.

The plating mill waste, constituting the bulk of flow requiring treatment, carries high cyanide and caustic alkalinity and small amounts of copper, nickel, aluminum, etc. No chrome plating is done in your present operations. The washing and cleaning wastes carry high quantities of oil and alkalinity. The character and flow of the wastes to be treated indicates that batch treatment is the most practical and economical method for preparing these wastes for discharge.

On our appended print No. B-474-W-1, we show a flow scheme for obtaining complete treatment of the discharged wastes.

A battery of four 10' in diameter by 10' high tanks, having an operating capacity of 5000 gallons each, to receive the wastes as discharged, is recommended. These tanks to have concrete bottoms and wooden stave sidewalls. Each tank to be equipped with motor operated paddles for a slow mix of treatment chemicals with the accumulated waste. Each tank to be equipped with multiple draw-off outlets for removing the treated and clarified wastes.

The chemicals required for treatment are sulfuric acid and calcium hypochlorite, containing approximately 70% available chlorine. These materials to be batch fed from tanks conveniently located for gravity flow of the chemicals to the point of treatment. The sulfuric acid may be fed in concentrated form and the Perchloron or HTH to be made into a slurry immediately before use and fed in the wet state.

For handling the small volumes of washing and cleaning wastes, we suggest two gravity separation tanks to receive the discharge. This waste being particularly high in oil, we propose collection tanks to be equipped with surface skimmers to remove the free oil following the separation period. Following the oil skimming, the liquid wastes to be taken to one of the plating mill waste tanks for final treatment. If sufficient oil is not removed by settling, we suggest the use of sulfuric acid to promote oil separation. The gravity tanks, under this method of treatment, to be equipped with an air grid, using air as the mixing medium in the acidification process.

The plating mill wastes to discharge directly to one treatment tank until it is practically full, then the discharge directed to the next tank, etc.

The procedure for treating the waste is as follows: After the tank has received its capacity of waste, the paddle agitator is put in motion. The flow of sulfuric acid is then started and sufficient added to reduce the pH to a point between 6.0 and 6.5 in the entire mixture. A short mix is given and the calcium hypochlorite slurry is started. Approximately 400 ppm of this material are added, the treated mixture now having a pH between 7.2 and 7.6. The mixing period, after the calcium hypochlorite has been added, must be at least 30 minutes or until good coagulation has taken place. The paddles are stopped and the reaction and settling time required is approximately 12 hours. By this time there exists at least 95% clear, non-toxic liquid suitable for discharge to a stream or municipal sewer. Approximately 5% or less sludge is settled in the bottom of the basin following the reaction and settling time. After the supernatant liquid has been withdrawn, the mechanical mixer is started, the bottom blade of which is equipped to scrape the sludge toward the center outlet, and the sludge valves opened. The sludge is discharged to a drying lagoon. The sludge as discharged is non-toxic and should dry relatively fast. We have estimated the maximum amount to be 5% or 250 gallons

per tank; however, laboratory studies on this treatment indicate approximately 3% sludge. Such material may be readily handled in earthen lagoons for drying by solar evaporation and seepage.

The estimated capital cost for equipment as described, installed with inter-connecting piping, etc., is $25,000.00. This does not include excavation, long pipe lines or lagoon construction. These latter items are difficult to estimate since locations and elevations are not established.

Operating costs for chemicals are estimated to be $.90 per thousand gallons of waste treated. These estimates are based on treatment of wastes similar to the composite submitted to our laboratory. Acid costs were figured at $.0175 per pound and calcium hypochlorite at $.24 per pound.

It is estimated that the cycle of treatment, reaction and settling will require 13 hours, approximately 1 hour or less for treatment with acid and calcium hypochlorite solution, and the remainder for reaction and settling. Also included in this overall time estimate is the time required for supernatant draw-off and sludge removal. If it were desirable to have all treatment take place on the day shift, it would be necessary to install at least one additional treatment tank.

The clarified supernatant following complete treatment will have a pH value between 7.2 and 7.8, cyanide content of less than 0.1 ppm, and other undesirable constituents reduced to a negligible minimum. It is essential that the long settling and/or reaction time be provided in order to assure a high grade effluent.

SECTION NO. 3 - CONCLUSIONS AND RECOMMENDATIONS

We can conclude from the foregoing that the plating mill wastes and the washing and cleaning wastes may be satisfactorily treated, with a minimum of equipment, a minimum of chemicals and operating labor. The effluent produced will meet any requirements of the Pennsylvania Department of Health Sanitary Water Board and is of such character that it may be discharged satisfactorily to a municipal sewerage system. A minimum of non-toxic sludge is produced by the foregoing treatment which may be readily handled by open lagoons.

The treatment tanks can be most economically constructed by the use of a properly formed base and bottom of concrete and the sides of wooden stave. The agitator mechanism may have constant speed drive, a maximum velocity in the mixer of 1' per second, and the bottom paddle so designed to conform with the tank bottom and move the precipitated sludge to the center outlet.

Take-off for the clarified liquid may be either multiple side outlets or a floating surface decanter.

No elaborate chemical feeding equipment is required for the sulfuric acid, it being fed in the concentrated form from a small storage tank. The calcium hypochlorite should be made into a slurry form for maximum utilization of the material. An agitator need be provided for this tank in the preparation of the slurry. All chemical feed should be located to obtain gravity flow to the point of usage. The plant operator should be provided with suitable testing equipment for the control of the various phases of treatment and the final effluent. After the plant has been in operation, convenient charts may be plotted in order to assist the operator in determining chemical dosages.

Since the waste treatment facilities are to be designed prior to the proposed plant installation, we recommend that they be included as an integral part of the design. In so doing, the units may be arranged for gravity flow of all wastes to the point of treatment. The only pumping which can be foreseen is the discharge of the settled sludge to the drying lagoons.

The proposed lagoons should be capable of handling sludge for extended periods without requiring cleaning. We would recommend at least three lagoons be constructed in order that while one lagoon is being used, the others may be draining and drying for subsequent usage. It is recommended that the lagoons be sized to hold at least two to three months wet sludge. Upon drying of the sludge, the lagoons may again be turned into active use until the capacity has been reached, at which time it will be necessary to remove the dried sludge. It will be desirable to equip the lagoons with a floating surface take-off in order to remove the clarified liquid resulting from long settling periods.

The treatment plant as indicated on the attached flow scheme can be compact, comparatively simple to operate, and produce a satisfactory effluent. As you are probably aware, plating mill wastes have certain characteristics which require practically complete treatment for their discharge to a stream or to a municipal sewerage system.

We trust you will find the report clear and complete in all phases, and we shall be pleased to further discuss in more detail any part of it which you may desire. We express our appreciation for the courtesy shown during the conducting of the field study and assure you of our continued interest and co-operation in preparing the final design.

Respectfully submitted,

W. H. & L. D. BETZ

Max U. Priester

Max U. Priester
Assistant Director
Consulting Division

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CERTIFICATE OF ANALYSIS

Penn Rivet & Machine Company
Philadelphia, Pa.

Samples Dated: 2/10/47

Sample Marked:	Plating Mill	Cleaner Waste 1st Pass	Cleaner Waste 2nd Pass
Analysis No.	B-1847	1848	1849
Color Units	520	1500	1100
pH (elect.)	11.51	12.05	12.18
Oil, ppm	68	1828	160
Suspended solids, ppm	262		
Settleable solids, cc/liter	0.5%	5%	1%
Cyanide as CN, ppm	102		
Copper as Cu, ppm	2.68		
M Alkalinity, ppm	1104	59,200	8110
P Alkalinity, ppm	580	49,300	7250